ULTIMATE ICU & SURGICAL FLUID MANAGEMENT GUIDE

Maintenance, Resuscitation, and Post-Operative Hourly Titration Protocols

1. CALCULATIONS & CLINICAL TARGETS

4-2-1 Hourly Maintenance

0-10kg: 4 mL/kg/hr

10-20kg: 2 mL/kg/hr

>20kg: 1 mL/kg/hr

*Ex (75kg): 40+20+55 = **115 mL/hr***

Hemodynamic Targets

MAP: >65 mmHg (Sepsis/Renal)

UOP: >0.5 mL/kg/hr (Standard)

CPP: 60-70 mmHg (Neuro Cases)

SVV: <12% (Fluid Responsive)

Fluid Stewardship (ROSE)

Resuscitation: Bolus therapy

Optimization: Target-based

Stabilization: Maintenance

Evacuation: Diuresis/Removal

2. CLINICAL PROTOCOLS & HOURLY RATES

Post-Operative (Major/ERAS) — GOAL-DIRECTED

Preferred Fluid: Balanced Crystalloids (LR).

Protocol: Restrictive/Euvoluemic strategy. Use GDFT (SVV monitoring). Avoid fluid overload to prevent ileus and anastomotic leaks.

Risk: Bowel edema, pulmonary complications, surgical site infection.

Hourly Rate: 40 - 80 mL/hr (Restricted) | 1 - 1.5 mL/kg/hr (Standard)

Diabetic Ketoacidosis (DKA) — EMERGENT

Preferred Fluid: 0.9% NS initially → D5 1/2 NS when Glucose <250.

Protocol: 1L in 1st hour, then replace 50% deficit in 8h. Transition to glucose-containing fluid to prevent hypoglycemia during insulin infusion.

Risk: Cerebral edema (in rapid drop), Hypokalemia.

Hourly Rate: 250 - 500 mL/hr (Initial) → 150 - 200 mL/hr (Maintenance)

Ischemic Stroke (ICVA) — NEURO-PROTECTION

Preferred Fluid: 0.9% Normal Saline.

Protocol: Maintain Euvolemia. Avoid Hypotonic fluids (D5W/0.45% NS) which worsen cerebral edema. Keep MAP for cerebral perfusion.

Risk: Cerebral edema, increased ICP.

Hourly Rate: 75 - 125 mL/hr (Euvolemic maintenance)

Hemorrhagic Stroke (HCVA) — ICP CONTROL

Preferred Fluid: 0.9% NS (Isotonic). Avoid D5W.

Protocol: Strict BP control (SBP <140-160). Avoid fluid overload which increases peri-hematomal pressure. Hypertonic Saline if ICP high.

Risk: Expansion of hematoma, increased ICP.

Hourly Rate: 80 - 100 mL/hr (Conservative maintenance)

Sepsis & Septic Shock — RESUSCITATION

Preferred Fluid: Balanced Crystalloids (LR/Plasma-Lyte).

Protocol: 30 mL/kg bolus in 3h. If MAP <65, start Vasopressors. Use Albumin if massive volume needed.

Risk: Hyperchloremic acidosis (with NS), Multi-organ failure from overload.

Hourly Rate: 500 - 1000 mL boluses → 100 - 150 mL/hr (Maintenance)

Renal Failure (AKI) — RESTRICTIVE

Preferred Fluid: Balanced Crystalloids.

Protocol: Small boluses (250mL). Restrict if no response. Use Vasopressors early to maintain Renal Perfusion Pressure.

Risk: Pulmonary edema, Hyperkalemia (with LR in severe AKI).

Hourly Rate: 50 - 75 mL/hr (Restrictive) or matching UOP

Cardiac Failure (HF) — VERY RESTRICTIVE

Preferred Fluid: Minimal Crystalloids.

Protocol: Diuretics + Inotropes. Preload-responsiveness (PLR) is mandatory before any bolus.

Risk: Acute Pulmonary Edema, Right heart failure.

Hourly Rate: 30 - 50 mL/hr (KVO)

Respiratory Failure (ARDS) — CONSERVATIVE

Preferred Fluid: Conservative Strategy.

Protocol: Aim for neutral/negative balance after shock resolution. Minimize extravascular lung water.

Risk: Worsening hypoxia, prolonged ventilation.

Hourly Rate: 40 - 80 mL/hr (Conservative)

Liver Failure (Cirrhosis) — COLLOID FOCUS

Preferred Fluid: 20% Albumin + Balanced Crystalloids.

Protocol: Avoid NS (Sodium retention). Albumin for SBP/HRS. Monitor for Abdominal Compartment Syndrome.

Risk: Ascites expansion, variceal bleeding.

Hourly Rate: 60 - 90 mL/hr (Conservative)

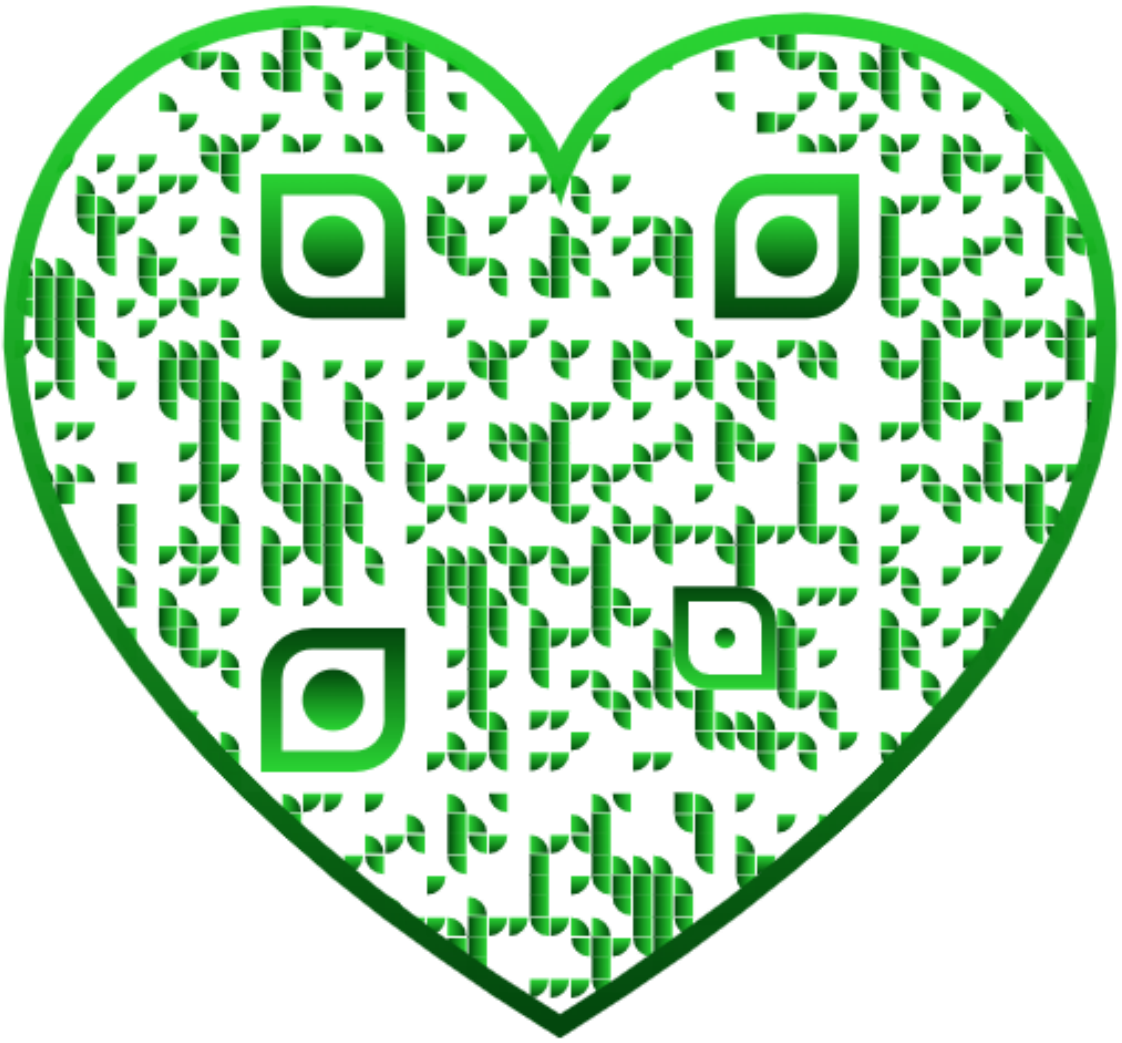
Hemorrhagic Shock — TRAUMA

Preferred Fluid: Blood Products (1:1:1 Ratio).

Protocol: Permissive hypotension. Limit crystalloids to <1.5L. Warm all fluids to prevent hypothermia.

Risk: Lethal Triad (Acidosis, Coagulopathy, Hypothermia).

Hourly Rate: Titrate to SBP 90 mmHg (Rapid Transfusion)



3. FLUID COMPARISON & SELECTION MATRIX

Fluid Type	Hourly Rate Range	Best Clinical Use	Avoid In / Risk
Balanced (LR/PL)	80 - 150 mL/hr	Sepsis, Major Surgery, Post-Op	Severe Renal Failure (K+ risk)
Normal Saline (0.9%)	75 - 125 mL/hr	Stroke, TBI, Alkalosis, DKA	Sepsis (Acidosis), Renal Failure
Albumin (5%/20%)	Bolus / 25-50 mL/hr	Cirrhosis, SBP, Massive Resus	ARDS (Leaky capillary risk)
Blood Products	Rapid / Titrated	Trauma, Active Bleeding	TRALI, TACO, Transfusion Reactions

Clinical Reference Only: Hourly rates must be individualized based on weight and organ function. Reference-Free Professional Guide.